

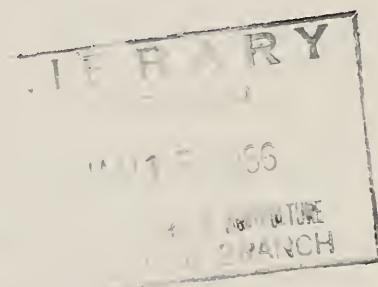
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PRODUCE PACKAGING AT THE CENTRAL WAREHOUSE-- BANANAS



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PREFACE

Most produce departments in supermarkets have reported, during the past few years, that their operating costs have increased and that their share of total store sales has decreased. The layouts, equipment, materials, and improved operations described in this report present the industry an opportunity to substantially lower the costs of selling bananas.

The research was conducted under the general supervision of R. W. Hoecker, Chief, Wholesaling and Retailing Research Branch, Transportation and Facilities Research Division, Agricultural Research Service.

Management of the following firms cooperated with the researchers in the use of their facilities for this study: Food Fair Stores, Miami, Fla.; Red Owl Stores and Super Valu Stores, Hopkins, Minn.; and Safeway Stores, Washington, D.C. The author would like to thank the many manufacturers of equipment and packaging materials who contributed time and materials.

Special credit is due Gordon J. Flynn and Thad T. Uehling who were formerly associated with the U.S. Department of Agriculture and who were responsible for major parts of the research.

Trade names are used in this publication solely for the purpose of providing specific information. Mention of commercially manufactured products does not imply endorsement by the Department of Agriculture over similar products not mentioned.

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SUMMARY

The costs of preparing bananas for sale and of product shrinkage during display are lowest when the bananas are wrapped in a sleeve of heat-shrinkable film at the central warehouse. The film wrap protects the product, prevents the removal of bananas, and provides a surface for the label, which can be automatically prepared and applied to the package. Film wrapping bananas at the central warehouse on an improved packaging line has potential savings of 43 cents per 40-pound box when compared with the typical method of tape banding bananas at the retail store. In a firm which sells 3,000 boxes per week, the annual savings would be \$67,000.

In one 4-week study, tape-banded bananas prepared at the retail store were compared with bananas film wrapped on an experimental packaging line at the central warehouse. There was no difference in sales for the two methods of handling, but markdowns for the film-wrapped bananas were 33 percent less than those of the tape-banded bananas. Preparation and shrinkage costs for the bananas film wrapped at the warehouse were 31 cents per box less than costs of bananas tape banded at the retail store.

In a second study, bananas film wrapped at the central warehouse were compared with loose clusters (nonbanded bananas) prepared at the retail store, which were weighed and priced at the checkout counter. There was no statistical difference in the sales of the bananas sold by the two methods. Shrinkage cost was 16 cents per box for film-wrapped bananas and 41 cents per box for the nonbanded bananas. When the comparison between the two methods includes both preparation and shrinkage costs, the warehouse film-wrapped bananas cost 15 cents per box less than the nonbanded bananas. Equipment layout and work methods for an improved packaging line, with semiautomatic sleeve banding, automatic weighing and labeling, and better product handling, were developed for warehouse film wrapping. It is estimated the preparation and shrinkage costs of this line would be 32 cents less than nonbanded bananas prepared at the retail store.

The main reason for the savings through unitizing the clusters is the reduction of shrinkage. The greater shrinkage for the nonbanded clusters was due principally to customer handling and removal of bananas from the clusters, which tended to reduce the average size of the consumer's purchase. The loose bananas and the damaged fruit were either marked down in price or discarded.

Tests are being conducted on the film-sleeve packaging of bananas in the growing area. A major problem is the availability of a film which will give the desired package appearance on the retail shelf. Another problem is the probability that the weighing and pricing cannot be performed at the source. The alternatives are pricing at the retail store or the central warehouse. Pricing on a special line at the central warehouse which included an electronic computing scale and an automatic labeler would be 9 cents per box. The lowest cost weighing and pricing at the retail store would be 27 cents per box when the clusters are priced with improved methods and equipment in the backroom of the retail store. For those stores that weigh produce at the checkout counter, the cost would be 12 cents per box.

PRODUCE PACKAGING AT THE CENTRAL WAREHOUSE--BANANAS

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BACKGROUND

A number of high-volume items in the produce department of supermarkets are available throughout the year--apples, grapefruit, onions, oranges, potatoes, lettuce, and bananas. In three retail food chains, bananas alone accounted for 8 to 10 percent of the produce items purchased. These high-volume items are usually prepared for sale at the retail store--in the backroom or in the produce department.

If bananas and the other major-volume items can be handled at lower cost, and if quality can be maintained at a high level, producers, distributors, and consumers will benefit.

Studies were made to compare the cost of preparing bananas for sale at the central warehouse with various methods of preparation at the retail store, and to determine the cost of product shrinkage associated with these methods. Observations in retail produce departments revealed a considerable amount of shrinkage (waste and price markdown) for bananas.

At the retail store, bananas are typically prepared for sale as loose clusters (referred to subsequently as nonbanded clusters) or the clusters are banded with tape. Nonbanded clusters may be priced prior to display (prepriced) or they may be weighed and priced at a customer service counter in the produce department or at the checkout counter. Banded clusters are commonly prepriced.

In previous publications, the preparation cost of prepriced, nonbanded clusters was compared with that of tape-banded bananas.¹ The preparation cost was higher for tape-banded bananas, but this cost was more than offset by a 29-percent reduction in product shrinkage.

The present report compares the cost of preparing film-wrapped clusters at the central warehouse and the cost of product shrinkage with costs of two methods of preparation at the retail store--tape-banded clusters and nonbanded clusters weighed and priced at the checkout counter. The film-wrapped clusters were prepared on an experimental packaging line at the central warehouse. Improvements were developed in the experimental line to increase its efficiency.

Another objective of this study was to determine where and how to price banana clusters which are film wrapped in the growing area.

The study is based on handling an annual volume of 156,000 boxes of bananas at the central warehouse (3,000 boxes per week) and an average annual volume of 1,500 boxes at a retail store. A box of bananas weighs 40 pounds. We assumed an average of 22 clusters of bananas per box.

The terms used herein to describe different units of bananas are those common to the produce industry. A finger is a single banana. A cluster is more than one banana and is the purchase unit selected by the customer. A hand is several clusters and is the unit which is typically shipped from the growing area.

Details on labor requirements and costs, and the costs for packaging material, equipment use, and burden (rent, utilities, insurance, laundry, etc.) are given in the appendix.

¹ Shaffer, Paul, and Wischkaemper, Paul. Cost and sales results of alternative methods of handling bananas. U.S. Dept. Agr. AMS-149, 10 pp., illus. 1956. Out of print. Results of AMS-149 are summarized in--

Shaffer, Paul, Anderson, Dale, Wischkaemper, Paul, and Karitas, James. Packaging and price-marking produce in retail food stores. U.S. Dept. Agr. Mktg. Res. Rept. No. 278, 85 pp., illus., 1958.

TAPE-BANDED CLUSTERS AT RETAIL STORE AND FILM-WRAPPED CLUSTERS AT CENTRAL WAREHOUSE

DESCRIPTION OF METHODS

The cost of tape banding and pricing bananas at the retail store was compared with the cost of packaging bananas in a sleeve of heat-shrinkable film and pricing at the central warehouse. This study was conducted in the central warehouse and eight stores of a midwestern retail food chain.

A 4-week test was made at the retail stores to measure shrinkage and sales of bananas prepared by the two methods. The produce departments of the stores were completely self-service, with all items either prepriced or packaged. During each week of the test, four stores received bananas in the normal manner (bulk) and four other stores received bananas packaged in a sleeve of film. (The experimental design is described in the appendix.)

Bananas were prepared for sale in the backroom at the retail store. Preparation consisted of breaking the hands into clusters, weighing the clusters on a high-platform scale, and taping them with a 3/8-inch band of pressure-sensitive crepe-backed tape. A desk-type tape dispenser was used. The price and number of bananas in the cluster were written on one of the bananas. The taped clusters were repacked in boxes for transport to the produce department. Off-quality bananas (markdowns) were placed in paper sacks with handles and sold at a reduced price. The labor requirements for this preparation method, and the other methods discussed in this report, include transporting boxes to the produce department, placing clusters on display, and handling trash and markdowns.

Improvements were made in the typical method of tape banding bananas in a previous study.² In the improved method, there is a fixed workplace for handling bananas. A low-platform scale is used instead of a high-platform scale, and the tape-dispenser is mounted so it is easily accessible (fig. 1). Several handling elements involved in tape banding bananas were combined to increase the worker's efficiency. A right-handed worker, for example, placed bananas to be prepared to the right of the scale and completed clusters to the left. He picked up a cluster with his right hand and placed it on the scale. He read the price of this cluster, picked it up with his left hand, and at the same time moved another cluster onto the scale with his right hand. Holding the first cluster in his left hand, he pulled out tape with the right, wrapped it around the cluster, and then wrote on one of the bananas the price and number of bananas in the cluster. As he disposed of the taped cluster with his left hand, he took a new one with his right and read the price of the cluster on the scale. After a short period of practice, this becomes an easy, rhythmical operation.

At the central warehouse, an experimental packaging line was set up to package bananas in the film sleeve. Equipment consisted of a turntable to hold clusters, two roll-film packaging devices (fig. 2), a conveyor, a shrink tunnel, an accumulation table, an electronic computer scale and printer, and a packout station with tare scales. After considerable experimentation, it was determined that a 10-inch-wide sleeve of heat-shrinkable polyvinyl chloride film that shrinks on the lengthwise axis only (machine-direction oriented) resulted in the best package appearance on the retail display (fig. 3). The type of shrink tunnel, the temperature, and the duration of the package in the tunnel are determined by the thickness of the film, the air velocity, and the flow of air about the package. When the tunnel temperature was 280° F., the underskin temperature of the bananas rose by 1 degree.

A forklift truck operator brought palletloads of bananas in 40-pound boxes to the packaging line. At the beginning of the line, a worker removed boxes from the pallets, broke hands into clusters, trimmed the crown when necessary, and placed the clusters on the turntable. Two girls at the packaging devices picked the clusters from the turntable, wrapped the film loosely around them, sealed the film on hot plates, and placed the packages on the conveyor. The conveyor

² See footnote 1.



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Figure 1.--An improved work station for tape banding bananas and packaging other produce items at a retail store. Tape dispenser is mounted at left of scale.



BN 24584

Figure 2.--The roll-film packaging device incorporates a roll of film, a surface on which the product is placed while the film is wrapped around it, a hot wire cut-off (to cut the film), and a Teflon-covered hot plate to seal the film.



BN 24585

Figure 3.--Banana clusters wrapped in heat-shrinkable film. The paper which covers the crown was not used in this study.

transported the clusters through the shrink tunnel and onto the accumulation table. Here a worker placed clusters on the electronic scale and applied the price labels prepared by the scale printer. From a supplementary test, it was found that clusters of bananas weighing an average of 1.8 pounds lost approximately 0.02 pound per day per cluster (fig. 4). The scale was tared for this amount. A worker carefully repacked the banana clusters in their original boxes. At the packout station, the boxes were placed on the tare scales to insure that they weighed 40 pounds. The fork-lift truck operator transported palletloads of the prepared boxes to storage.

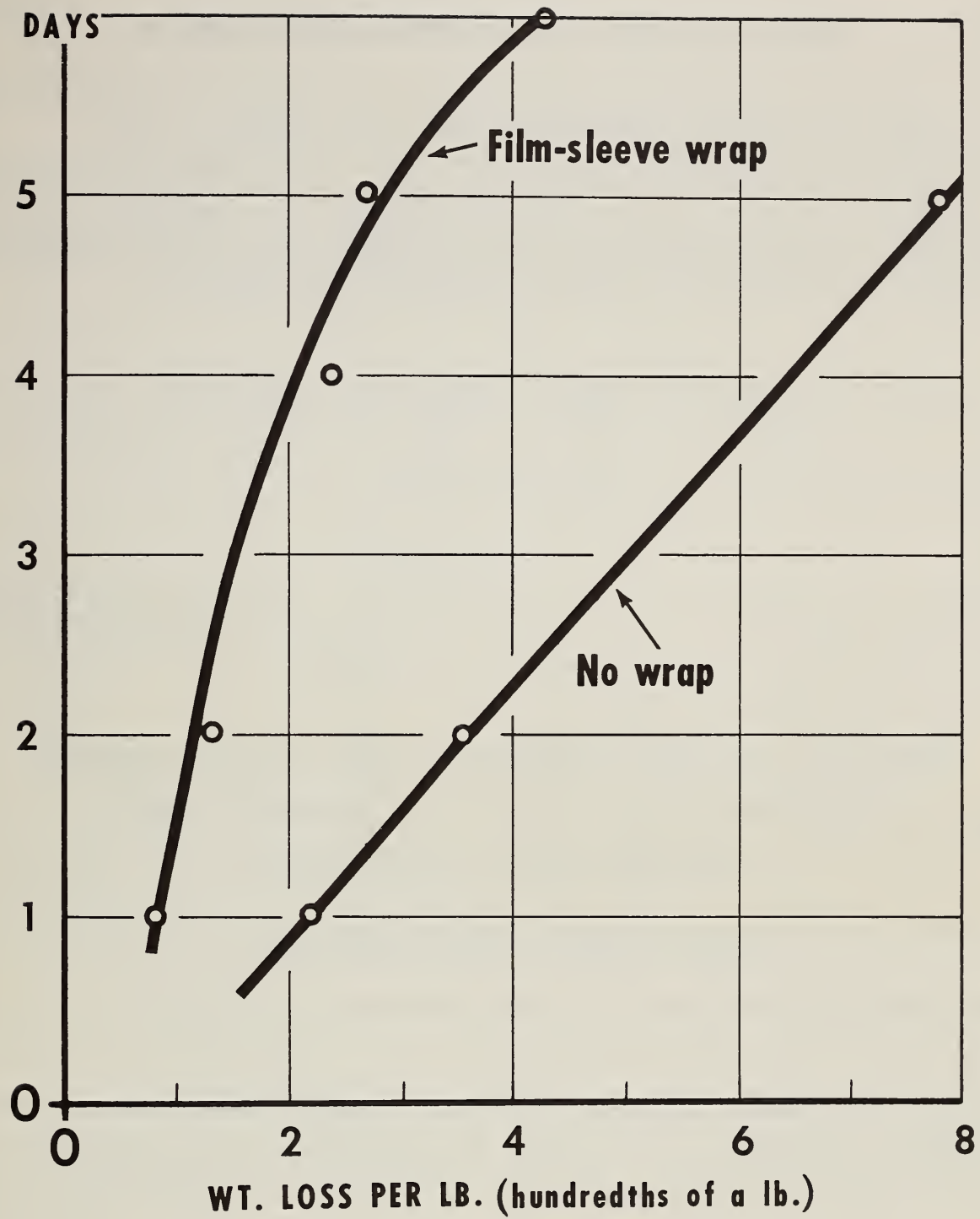


Figure 4.--Weight loss of bananas.

PREPARATION AND SHRINKAGE COSTS

Table 1 gives the preparation costs per 40-pound box for the typical and improved methods of tape banding at the retail store and for film wrapping at the central warehouse.

Preparation cost at the central warehouse was about 2 cents less per box than store preparation of tape-banded bananas with the improved method, and 27 cents less than with the typical method. Labor costs at the central warehouse were high, which is a reflection of the temporary test installation.³ The labor costs of tape banding were reduced from 64 to 39 cents per 40-pound box when improved equipment and work methods were used at the retail store.

TABLE 1.--Tape-banded bananas prepared at retail store and film-wrapped bananas prepared at central warehouse: Cost of preparing for sale per 40-pound box¹

[Based on an annual volume of 1,500 boxes at retail store and 156,000 boxes at central warehouse]

Cost factor	Tape-banded at retail store		Film-wrapped at central warehouse on experimental packaging line
	Typical method	Improved method	
	<u>Cents</u>	<u>Cents</u>	<u>Cents</u>
Labor.....	64.2	39.1	39.5
Materials.....	9.1	9.1	11.9
Equipment.....	2.5	2.5	.8
Burden.....	4.9	4.9	1.3
Total.....	80.7	55.6	53.5

¹ See appendix for explanation of cost determinations.

The test results showed a significant difference in shrinkage between tape-banded and film-wrapped bananas. Shrinkage was 1.84 percent of the total pounds sold for tape-banded bananas and 1.23 percent for film-wrapped bananas (see appendix table 10 for further details). This is equivalent to a cost of 10.9 cents per box for tape-banded bananas and 7.3 cents for film-wrapped bananas, for clusters averaging 1.8 pounds and a selling price of 15 cents per pound. There was more product shrinkage for the tape-banded bananas than for film-wrapped bananas each week of the 4-week test. There was no significant difference in the means of stores or treatments during the study.⁴

The total cost of preparation and shrinkage, per box and per year, for an annual volume of 156,000 boxes of bananas, is given in table 2 for the two methods of preparation. Annual savings to a firm which moved banana preparation to the central warehouse, and replaced tape banding with a 10-inch-wide film sleeve, would be \$47,000 dollars. If the improved method of tape banding were used at retail stores instead of the typical method, savings would be \$39,000.

³ An improved central warehouse banana packing line is described on page 13.

⁴ The statistical tests to measure the differences in shrinkage between the methods of preparing bananas for sale are available on request.

TABLE 2.--Tape-banded bananas prepared at retail store and film-wrapped bananas prepared at central warehouse: Total cost of preparation and cost of shrinkage, per box and per year

[Based on an annual volume of 156,000 boxes]

Preparation method	Costs per box			Total cost per year	Annual savings compared to typical method of tape banding at retail store
	Preparation	Shrinkage	Total		
Tape-banded at retail stores:	<u>Cents</u>	<u>Cents</u>	<u>Cents</u>	<u>Dollars</u>	<u>Dollars</u>
Typical method....	80.7	10.9	91.6	142,896	--
Improved method...	55.6	10.9	66.5	103,740	39,156
Film-wrapped at central warehouse on experimental packaging line....	53.5	7.3	60.8	94,848	47,048

NONBANDED CLUSTERS AT RETAIL STORE AND FILM-WRAPPED CLUSTERS AT CENTRAL WAREHOUSE

DESCRIPTION OF METHODS

Another test compared the preparation costs and shrinkage when bananas were prepared as nonbanded and unpriced clusters at the retail store (the clusters were weighed and priced at the checkout counter) and when they were wrapped with a film sleeve at the central warehouse. The test was conducted in eight stores during a 4-week period. During each week of the test period, four stores received bulk bananas and four stores received bananas prepriced and wrapped in film. The produce managers of the stores kept records of boxes received, weekend carryovers, weight and price of markdowns, price changes and weight of bananas affected, and weight of trash.

To prepare bananas for sale at the retail store, the clerk transported one or more boxes of bananas to the display area. He opened the boxes, broke the hands into clusters, inspected the bananas, and placed them on display. Off-quality fruit was placed in handle-type paper bags and sold at a reduced price or disposed of as trash. The clusters were weighed and priced at the checkout counter.

The packaging line which was set up at the warehouse for this test was similar to that used in the previous study, except that boxes were placed on a sloped table so the hands could more easily be removed. Also, a mechanical device was used to trim the crown. The clusters were wrapped in film, weighed, priced, and repacked in boxes as in the previous study.

PREPARATION AND SHRINKAGE COSTS

The nonbanded bananas were weighed and priced at the checkout counter, at a labor cost of 7.8 cents per box.⁵ This cost was included in the preparation cost for this method.

Total cost of preparation for nonbanded bananas was 10.6 cents less per box than the cost for film-wrapped clusters at the warehouse (table 3). The loss per box in shrinkage, however, was 41.4 cents for the nonbanded bananas, compared to 15.9 cents for the film-wrapped clusters. This gives a cushion of 25.5 cents a box to absorb the preparation cost for film wrapping.

The film wrap prevented the clusters from being torn apart and protected the bananas during warehouse and store handling. Also, film-wrapped bananas retained their color while the non-banded fruit took on a greyish cast. This was demonstrated by displaying bananas from the same hand as nonbanded and film wrapped.

The differences in markdowns were the most significant finding of the study. There were 4½ times as many markdowns in the nonbanded displays as in the film-wrapped displays, and trash was twice as high for nonbanded bananas.⁶ Details on markdowns and trash are given in appendix table 11.

In a separate test, the warehouse markdowns were packaged in trays holding 3 to 4 pounds of bananas and wrapped with a 10-inch band of heat-shrinkable film. They were shipped to stores, and, when priced in accordance with established markdown practices, moved very fast as compared to the conventional method of placing markdowns in handle-type paper bags.

TABLE 3.--Nonbanded bananas prepared at retail store (weighed and priced at checkout counter) and film-wrapped bananas prepared at central warehouse: Cost of preparing for sale per 40-pound box¹

[Based on an annual volume of 1,500 boxes at retail store and 156,000 boxes at central warehouse]

Cost factor	Nonbanded at retail store	Film-wrapped at central warehouse on experimental packaging line
	<u>Cents</u>	<u>Cents</u>
Labor.....	36.3	39.5
Materials.....	² 1.0	11.9
Equipment.....	4.4	.8
Burden.....	1.2	1.3
Total.....	42.9	53.5

¹ See appendix for explanation of cost determinations.

² Cost for paper bags used for markdowns.

⁵The alternative to weighing unpriced clusters at the checkout counter is handling them at a customer service counter in the produce department. In two stores where detailed studies were made of weighing at the service counter, the labor cost varied from 2.94 cents per cluster (65 cents per box) to 1.63 cents per cluster (36 cents per box) at an improved service counter. Anderson, Dale L. and Shaffer, Paul F. Display location and customer service in retail produce departments. U.S. Dept. Agr. Mktg. Res. Rept. No. 501, 50 pp., illus., 1961.

⁶There was a significant difference at the 5-percent level, in both markdowns and trash, between nonbanded and film-wrapped bananas. The difference was not significant between stores and weeks.

Over the test period, sales of film-wrapped bananas were 3 percent higher than sales of nonbanded bananas, but the difference was not significant for weeks, stores, or treatments.

Considering both costs of preparation and shrinkage, a firm handling 156,000 boxes of bananas a year would save \$23,000 by film-wrapping clusters at the central warehouse instead of preparing nonbanded clusters at retail stores (table 4).

TABLE 4.--Nonbanded clusters prepared at retail store (weighed and priced at checkout counter) and film-wrapped bananas prepared at central warehouse: Total cost of preparation and cost of shrinkage, per box and per year

[Based on an annual volume of 156,000 boxes]

Preparation method	Cost per box			Total cost per year	Annual savings compared to nonbanded clusters prepared at retail store
	Preparation	Shrinkage	Total		
Nonbanded clusters at retail stores (weighed and priced at checkout counter)	<u>Cents</u>	<u>Cents</u>	<u>Cents</u>	<u>Dollars</u>	<u>Dollars</u>
	42.9	41.4	84.3	131,508	--
Film wrapped at central warehouse on experimental packaging line	53.5	15.9	69.4	108,164	23,244

IMPROVED PACKAGING OPERATION FOR FILM WRAPPING BANANAS

A principal advantage of moving the packaging operation to the central warehouse is the use of specialized facilities. In both studies of the experimental packaging line, it was recognized that the packaging facilities were inadequate: The bananas were manually wrapped with film, a worker had to place packages on the scale and apply labels, and there was no accumulation area between work stations to balance out production. Based on the experience gained in the two studies of warehouse banana packaging and using the principles of motion economy, an improved operation was developed for lower cost packaging.

A double packaging line is used in the improved operation. Each line would consist of the following equipment: Semiautomatic film-sleeve bander, heat-shrink tunnel, electronic computing scale with automatic labeler, and conveyors leading between this equipment. Conveyors to move full and empty boxes, a turntable, and a packout area with tare weight scales are used for both lines. This double line would have a capacity of 200,000 boxes per year in a one-shift operation. Figure 5 is a layout of the double line; space required for the line is 750 square feet.

In the recommended operation, a forklift truck operator places palletloads of bananas in tropic-pack boxes on a floor-level conveyor (A), which can accommodate three pallets. One worker places full boxes on the supply conveyor (B), removes and places lids on an overhead conveyor (not shown in fig. 5) which moves them to the area where boxes of packaged bananas are palletized (J). Two workers move boxes from conveyor (B) to their work areas (C) and break the hands into clusters. Excess material on the crown is removed by trimming machine. Clusters are placed in the film sleeve banders (D). Sleeve-packaged clusters pass through the shrink

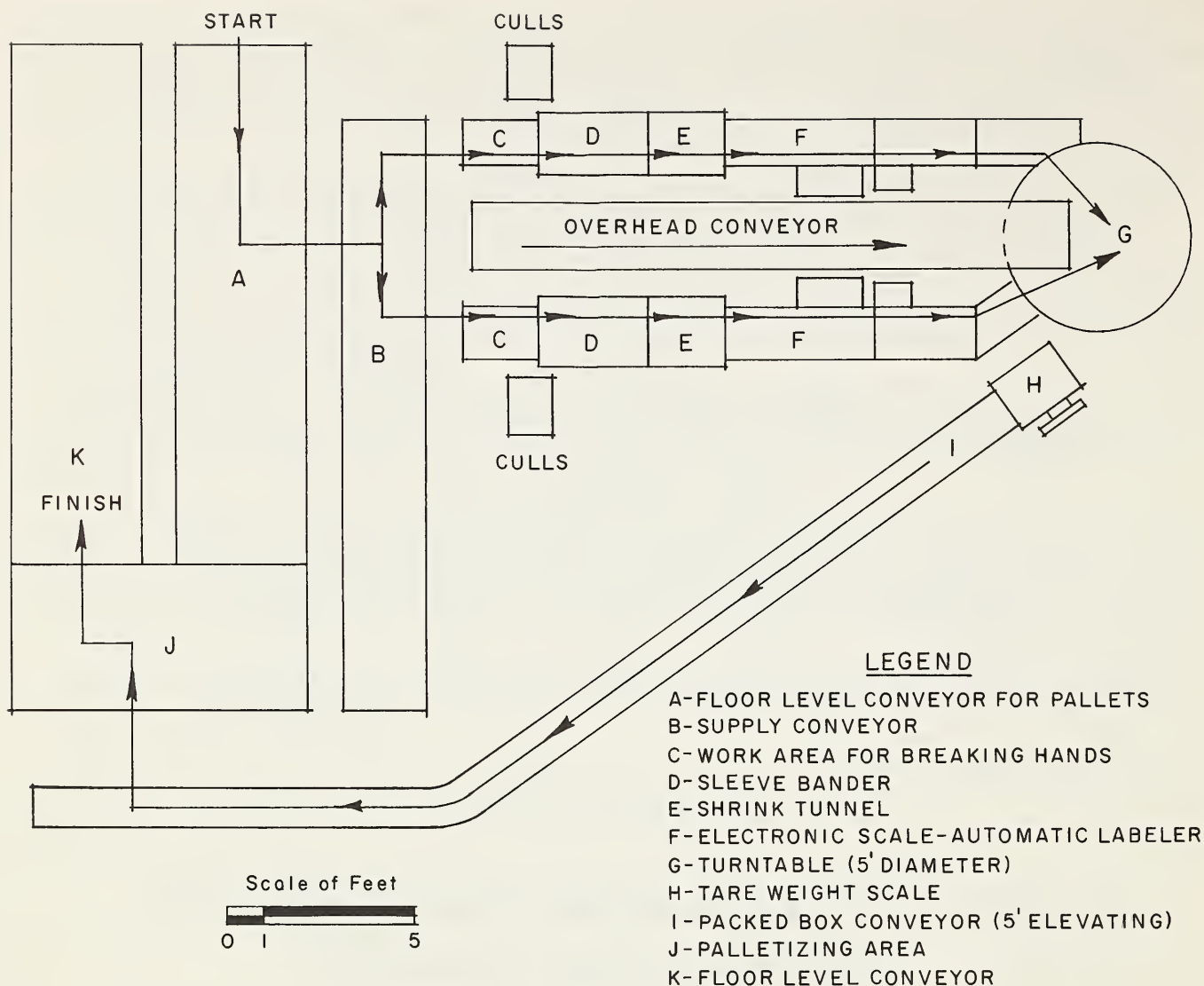


Figure 5.--An improved layout for film wrapping bananas at the central warehouse.

tunnels (E) and onto the electronic computing scales with automatic labeler (F). The priced clusters are then moved by conveyor to the packout turntable (G), where two workers pack clusters in a banana box which rests on a tare weight scale (H). The workers who remove hands from boxes at (C) place the empty boxes on an overhead conveyor, which moves them to the packout area. After the boxes are filled to 40 pounds, they are moved by conveyor (I) to the palletizing area (J), where a worker lids the boxes and places them on pallets. Loaded pallets are accumulated on a floor-level conveyor (K).

To achieve a balanced crew, some workers would perform more than one job. For example, the man who supplies the line with boxes of bulk fruit and the man who lids the boxes would help break the hands into clusters. Supply conveyor (B) and conveyor (I), which carries packed boxes to the palletizing area, provide ample accumulation area so that these workers can move from job to job.

Labor cost at the warehouse would be 16.2 cents per 40-pound box for a direct labor force of six employees on the line working at a crew speed of 40 clusters per minute, plus the time of a supervisor, forklift truck operator, and maintenance man that is chargeable to the banana packaging operation (see appendix table 9). Total labor (including work required at the retail

store to place bananas on display and handle markdowns) and other preparation costs are shown in the following tabulation:

	<u>Cents per box</u>
Labor.	29.0
Materials	11.9
Equipment.	2.3
Burden.	<u>1.3</u>
Total	44.5

It was the opinion of the researchers and supervisors of the firm that cooperated in the second test of the experimental line that shrinkage with the improved banana packaging operation would be reduced to one half of that which occurred with the experimental line. This would be a reduction from 15.9 to 8 cents per box. Total preparation and shrinkage costs for the improved line are therefore estimated at 52.5 cents per box.

DISCUSSION

The two studies reported here compared film-wrapped bananas prepared at the central warehouse with tape-banded and nonbanded bananas prepared at the retail store. The nonbanded bananas were weighed and priced at the checkout counter. A previous study compared tape-banded and prepriced nonbanded bananas prepared at the retail store.⁷ Preparation and shrinkage costs of the various methods, as found in each study, and estimated costs of the improved packaging operation at the central warehouse are summarized in table 5.

Labor and materials were the principal components of preparation costs. Material costs increased progressively as the cluster was more completely covered. Labor costs decreased when work methods, layout, and equipment was substituted for labor, as in the improved film-wrapping operation at the central warehouse. In this instance, the use of the combination electronic computing scale with printer and the automatic labeler eliminated the labor performed in weighing and pricing clusters.

Preparation costs were lowest for the nonbanded unpriced clusters and for the improved film wrap. The only material used in preparing nonbanded clusters was paper bags for markdowns. Despite the relatively high material costs for the improved film wrap, the total preparation costs were low because of the efficiency of labor. Preparation costs were highest for tape-banded bananas prepared by the typical method.

It is not possible to make direct comparisons of product shrinkage since the studies were separated by time and area, by different management and merchandising practices, and by varying product quality. It is possible to present some conclusions based on the test results and the observations of store personnel and the researchers. The highest shrinkage occurred for the nonbanded unpriced fruit because the customer could easily remove bananas from clusters; bananas separated from clusters typically were marked down in price. It would appear that writing the price on the cluster served in some measure to reduce removal of bananas (that is, the store, rather than the customer, determined the size of the cluster), because the shrinkage cost of prepriced nonbanded bananas was only half that of the unpriced nonbanded bananas.

⁷See footnote 1. The nonbanded prepriced bananas were prepared for sale in the backroom; the price and number of fingers per cluster were written on one of the fingers (see appendix table 8). Tape-banded bananas were prepared by the typical method described in this report.

TABLE 5.--Cost of preparation and shrinkage per 40-pound box of bananas, by method of preparation at retail store and central warehouse

[Based on an annual volume of 156,000 boxes at central warehouse and 1,500 boxes at retail store]

Method of preparation	Cost per box		
	Preparation ¹	Shrinkage	Total
RETAIL STORE			
	<u>Cents</u>	<u>Cents</u>	<u>Cents</u>
Nonbanded:			
Unpriced.....	42.9	41.4	84.3
Prepriced ²	46.6	21.0	67.6
Tape-banded:			
Typical method			
A ²	80.7	15.0	95.7
B.....	80.7	10.9	91.6
Improved method.....	55.1	10.0	66.0
CENTRAL WAREHOUSE			
Film-wrapped:			
Experimental line			
Test 1.....	53.5	7.3	60.8
Test 2.....	53.5	15.9	69.3
Improved line.....	44.5	8.0	³ 52.5

¹ See appendix for details on preparation costs.

² From previous study. See footnote 1, page 5. Wage rates were adjusted to rates used in present report.

³ When compared to tape banding in the retail store with typical methods, annual savings are \$67,000.

The film wrap was effective in reducing shrinkage, as was the tape band. The reduction in shrinkage costs due to the film wrap was most dramatic (from 41.4 to 15.9 cents per box) when compared with nonbanded unpriced bananas. The higher loss through markdowns and throwouts for nonbanded bananas offsets the higher preparation costs of unitizing bananas by tape or film wrap. For example, cost of shrinkage for the nonbanded unpriced clusters was almost half of total costs, whereas it was only 12 percent of total costs for the film-wrapped bananas (test 1 in table 5).

The test results did not give a clear pattern of the effect of the method of preparation on sales. When tape-banded clusters were compared with film-wrapped, the difference in sales was negligible and insignificant. There was a 3-percent increase in sales of the film-wrapped bananas when compared to nonbanded, but the difference was not significant and could have been due to other factors. In the previous study, sales of tape-banded bananas were 14 percent higher than those of prepriced nonbanded clusters.⁸ The increased net operating profit for tape-banded bananas was more than enough to overcome the slightly lower preparation cost of the prepriced

⁸See footnote 1.

TABLE 6.--Operating profit for retail sales of tape-banded bananas compared to nonbanded prepriced bananas, based on sales of one 40-pound box of nonbanded prepriced bananas

[Markup is 25 percent; selling price per pound is 15 cents]

Calculations	Nonbanded prepriced	Tape-banded	
		With the same sales as non- banded pre- priced	With sales 14% higher than nonbanded prepriced
	<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>
Value of bananas available for sale.....	8.00	8.00	9.01
Less shrinkage ¹.....	.29	.20	.22
Net sales.....	7.71	7.80	8.79
Less cost of stock.....	6.00	6.00	6.76
Gross margin.....	1.71	1.80	2.03
Less preparation costs ².....	.47	.55	.63
Net operating profit.....	1.24	1.25	1.40

¹Based on 3.58 percent of sales for nonbanded prepriced and 2.46 percent for tape-banded.

²Includes labor, equipment, materials, and burden.

nonbanded bananas (table 6). The reader can determine from the chart given in figure 6 in the appendix the amount of sales increase required for tape-banded bananas to be profitable at alternative selling prices and markup. For example, when bananas sell for 9 cents a pound and have 25-percent markup, a sales increase of 5 percent over normal sales of nonbanded bananas is required.

An increase in sales is not required to justify film wrapping at the central warehouse. The potential savings in preparation and shrinkage costs are \$50,000 per year, compared to nonbanded clusters weighed at the checkout counter, and \$67,000 per year compared to tape-banded clusters prepared by the typical method, for a volume of 156,000 boxes. As customers become accustomed to the film wrap, it is possible that sales will increase. If a firm is interested in reducing banana shrinkage and is concerned with mounting labor costs, the packaging operation can be moved to the central warehouse where specialized equipment and trained personnel can be used.

WEIGHING AND PRICING BANANAS WHICH ARE PACKAGED IN THE GROWING AREA

There has been considerable experimentation with materials and equipment for packaging bananas in the growing area. A major problem is the availability of a film which will give the desired package appearance on the retail shelf. If the testing of film wrapping in the growing area is successful, retail food firms will be faced with the problem of where to weigh and price the wrapped clusters.

There are several advantages to packaging bananas at source: (1) the bananas are better protected during transit from the growing area to the retail store display, (2) labor costs are lower in the tropics, and (3) it costs less to throw out fruit of questionable quality at the growing area. There are also some limitations to source packaging: (1) quality control is transferred from a representative of the buyer to the grower; (2) the package size or variety of sizes may not satisfy the buying habits of the retail store's customers, especially when bananas are on special sale; and (3) weighing and pricing are not practical at source because retail pricing must be flexible.

The lowest cost method of weighing and pricing bananas that are packaged in the growing area would be with the combination of electronic computing scale and automatic labeler at the central warehouse. Electronic scales can automatically weigh clusters at a rate of up to 32 clusters per minute. The pricing of bananas is almost completely automated with this equipment. The cost would be 13 cents per box with the electronic scale alone and 9 cents with the electronic scale used in conjunction with the automatic labeler (table 7).

Source-packaged bananas can be priced at the store by three methods: (1) at a weighing station in the backroom, with the price marked in crayon on the film wrapper or a label attached; (2) at a central weighing station in the produce department, with the price marked on the film with a grease pencil or ballpoint pen; or (3) at the checkout counter.

Bananas can be priced rather economically at the checkout counter (table 7), but it is unlikely that this method would be used in stores that have a central weighing station in the produce department or have a completely self-service prepriced produce department. The cost of checkout pricing of source-packaged bananas depends on the type of checkout counter. The average cost would be 11 cents per box.

The most costly place to price source-packaged bananas would be at the weighing station in the produce department. The cost would be approximately 50 cents per box. This high cost is due to the delays which are inherent in the operation. The attendant must wait for the customer and therefore the time assigned or allocated to pricing is determined more by the customer than by the store. The second highest cost location for pricing is at a work station in the backroom.

TABLE 7.--Cost per 40-pound box to weigh and price banana clusters film wrapped in the growing area, by various methods at the central warehouse and retail store¹

Weighing and pricing location and method	Labor	Equipment	Burden	Total cost per box
	<u>Cents</u>	<u>Cents</u>	<u>Cents</u>	<u>Cents</u>
Central warehouse:				
Electronic computer scale.....	10.7	0.7	1.3	12.7
Electronic computer scale with auto- matic labeler.....	6.3	1.8	1.3	9.4
Retail store:				
In backroom:				
Typical method.....	25.7	2.5	4.9	33.1
Improved method.....	19.7	2.5	4.9	27.1
At customer service counter in produce department.....	47.3	2.5	.5	50.5
At checkout counter.....	6.0	4.4	1.2	11.6

¹ No cost is included for materials because labels (@ 0.08 cent or \$1.91 per roll of 2,340 labels) used with the electronic scales are the only materials involved. This cost would not significantly affect the comparison. See appendix for explanation of other cost determinations.

The cost here will vary from 33 cents (under typical operating conditions) to 27 cents per box if an improved work station (see fig. 1) and methods similar to that described for tape-banding bananas are used.

The cost analysis indicates that the most economical method of pricing source-packaged bananas is at the central warehouse. A byproduct of central warehouse pricing is better quality control since personnel are virtually compelled to check the fruit as it is processed. Another advantage of pricing bananas at the central warehouse is that a shrink tunnel can be incorporated in the line, either before or after weighing, to tighten the wrap and improve the appearance of the package.

APPENDIX

PREPARATION COSTS

Labor

The labor requirements and costs of the various methods of preparing bananas for sale at the retail store and central warehouse are given in tables 8 and 9.

Equipment

Retail store.--Equipment ownership and operating costs at the retail store were based on an annual volume of 1,500 boxes of bananas. The same costs were allocated for tape-banded or nonbanded, prepriced bananas. The equipment consisted of:

Low or high platform scale @ \$250
Table @ \$100

The expected life of the equipment is 10 years; depreciation was figured on a straight line basis, and interest was 5.5 percent for half the life of the equipment. Maintenance was \$15 per year. One half the total ownership and operating costs was charged to bananas. The total cost per box was 2.5 cents for these methods of retail store preparation.

When nonbanded bananas were weighed and priced at the checkout counter, equipment costs were higher because: (1) Scales must be incorporated in the counter, (2) more checkout counters may be required because it takes longer to check out a customer when the clerk must weigh produce, and (3) checkweigh scales are required in the produce department so the customer can check the weight of nonpackaged items. The equipment cost for checkout pricing bananas was based on:

Additional checkout counter cost.....	\$45
Weighing scales incorporated in the checkout counter.....	\$182
Checkweigh scales in produce department.	\$37
Additional equipment required because weighing produce takes more time per order.....	\$67

TABLE 8.--Labor requirements and costs per 40-pound box for preparing bananas for retail sale,
by method at the retail store¹

Labor elements	Nonbanded				Tape-banded			
	Unpriced		Prepriced		Typical		Improved	
	Man- minutes	Cents	Man- minutes	Cents	Man- minutes	Cents	Man- minutes	Cents
Remove hands from box, break into clusters, weigh and write price and number of bananas in cluster on one banana.....	--	--	3.96	19.8	--	--	--	--
Remove hands from box, break into clusters, band with tape, weigh and price, and write number of bananas in cluster on one banana.....	--	--	--	--	8.24	41.2	5.26	26.3
Position full boxes on cart, transport from backroom to produce department (and return with empty boxes).....	1.04	5.2	1.04	5.2	1.04	5.2	1.04	5.2
Remove hands from box, break into clusters and place on display.....	2.38	11.9	--	--	--	--	--	--
Display clusters.....	--	--	.84	4.2	2.38	11.9	.84	4.2
Reweigh and price 10 percent of clusters at customer service counter	--	--	.26	1.3	--	--	--	--
Prepare markdowns, place in paper bag, weigh and write price on bags, discard trash.....	2.28	11.4	1.64	8.2	1.34	6.7	.68	3.4
Weigh unpriced clusters at checkout counter.....	1.56	7.8	--	--	--	--	--	--
Totals.....	7.26	36.3	7.74	38.7	13.00	65.0	7.82	39.1

¹ Wage rate is \$3.00 per hour.

TABLE 9.--Labor requirements and costs per 40-pound box for film wrapping bananas at the central warehouse, on experimental and improved packaging lines

Labor elements	Experimental packaging line		Improved packaging line	
	Man- minutes	Cents	Man- minutes	Cents
Labor at central warehouse:				
Remove hands from box, break into clusters, wrap in film, weigh and price, and repack in box.....	5.50	¹ 24.2	3.30	² 13.9
Supervise packaging line ³	--	1.6	--	1.6
Supply packaging line with pallet loads of boxes and remove packed boxes with forklift truck ⁴.....	.10	.5	.05	.3
Maintaining equipment ⁵	--	.4	--	.4
Labor at retail store: ⁶				
Position full boxes on stock truck, transport to display area and return with empty boxes to backroom.....	1.04	5.2	1.04	5.2
Remove clusters from box and place on display.....	.84	4.2	.84	4.2
Prepare markdowns, place in paper bags, write price on bag, discard trash.....	.06	3.4	.68	3.4
Total.....	--	39.5	--	29.0

¹Average wage rate is \$2.61 per hour (4.4 cents per minute) for crew of 3 females at \$2.29 per hour and 2 males at \$3.08 per hour. Production rate is 20 packages per minute; elapsed time per box is 1.1 minutes.

²Average wage rate is \$2.55 per hour (4.2 cents per minute) for crew of 4 females at \$2.29 per hour and 2 males at \$3.08 per hour. Production rate is 40 packages per minute; elapsed time per box is 0.55 minute.

³Salary is \$7,500 per year, with one-third of time allocated to banana packaging line.

⁴Wage rate is \$3.20 per hour. Production rate is one pallet of 20 boxes every 2 minutes for experimental line and one pallet per minute for improved line.

⁵Maintenance personnel on the average spent 3 hours per week in checking all equipment other than the electronic computing scale and automatic labeler. Their wage rate was \$3.50 per hour.

⁶Wage rate at retail store is \$3.00 per hour.

Bananas accounted for 20 percent of the produce items priced at checkout.⁹ The equipment cost per box was 4.4 cents.

Warehouse.--Equipment ownership and operating costs for the experimental and improved banana packaging lines at the central warehouse were based on an annual volume of 156,000 boxes. Equipment for the experimental line consisted of:

- 1 electronic computer scale and printer @ \$4,300
- 2 roll-film packaging devices @ \$100
- 1 heat-shrink tunnel @ \$500
- 1 forklift truck @ \$6,000
- Tunrtable, conveyors, and tare scale @ \$800

⁹For additional details see page 42, Anderson, Dale L., and Shaffer, Paul F. Display location and customer service in retail produce departments. U.S. Dept. Agr. Mktg. Res. Rpt. No. 501, 50 pp., illus. 1961.

Equipment for the improved line was:

2 electronic computer scales and printers @ \$4,300
2 heat-shrink tunnels @ \$500
2 automatic labelers @ \$2,500
2 semiautomatic film-sleeve banders @ \$2,885
1 forklift truck @ \$6,000
Turntable, conveyors, and tare scale @ \$1,300

The expected life of all equipment except the forklift truck is 10 years; depreciation was figured on a straight-line basis and interest at 5.5 percent for half the life of the equipment. The expected life of the forklift truck is 5 years; it is used one-third of the time, during one of three 8-hour shifts, for the banana packaging line (11 percent of total usage). The maintenance contract charge for the electronic scale was \$305 per year; the estimated maintenance cost for the automatic labelers is \$130 per year. Total annual interest cost for the experimental line was \$160 and for the improved line, \$596.

Equipment ownership and operating cost per box was 0.8 cent for the experimental packaging line and 2.3 cents per box for the improved line.

Burden

The burden charges for the purpose of this report consist of rent, utilities, insurance, laundry, and miscellaneous charges relating to occupancy of space.

Retail store.--A cost of 4.9 cents per 40-pound box of bananas is used as the burden charge for a retail store with an annual volume of 1,500 boxes of bananas, when bananas are prepared for sale in the backroom. This is based on an average cost of \$2.46 per square foot of store area, with 30 square feet of the produce department backroom (half of the produce weighing and pricing area) charged to bananas. The average burden or occupancy charge for several retail food chains in 1962 was 2.5 percent of sales, average sales per year were \$1,149,000, and the average store had 11,660 square feet.¹⁰

The burden charge for preparing nonbanded clusters that were weighed and priced at the checkout counter was computed as follows: The average store had seven counters, each occupying 138 square feet (including aisle space), for a total area of 966 square feet. At \$2.46 per square foot, the occupancy charge is \$2,376 per year. More counters are required in the store because 3.9 percent additional labor is needed. The added space charge to weigh produce at the checkout counter is \$92.66 (\$2,376 x .039). In this study, bananas were 20 percent of produce items weighed at the checkout counter. The cost per 40-pound box for a 1,500 box volume was 1.2 cents ($\frac{\$92.66 \times .20}{1,500}$).

Central warehouse.--The average occupancy charge for sufficient space for banana preparation at the central warehouse of the firms studied was \$2,000 per year or 1.3 cents per box ($\$2,000 \div 156,000$).

Packaging Materials

The cost of packaging materials per 40-pound box of bananas was computed as follows:

	<u>Cents per box</u>
3/8 inch pressure-sensitive crepe-backed tape @ 50 cents per 60-yard roll, 18 inches per cluster, and 22 clusters per box	9.13
Paper bags with handles for markdowns, estimated cost	1.00
Heat-shrinkable film, 10 inches wide, @ 2.78 cents per 1,000 square inches, 10 by 18 inches per cluster, and 22 clusters per box	11.00
Labels for film-wrapped bananas @ 0.04 cent, and 22 clusters per box.	.88

¹⁰ Progressive Grocer. Grocery Business Annual Report, 32 pp., 1964.

BANANA SALES AND SHRINKAGE AND EXPERIMENTAL DESIGN

The two studies of methods of preparing bananas for sale were made in separate groups of eight stores each, during different 4-week test periods. In the first study, four stores sold film-wrapped bananas prepared at the central warehouse, while four other stores prepared and sold tape-banded bananas. In the second study, four stores sold film-wrapped bananas prepared at the central warehouse, while four other stores prepared and sold nonbanded bananas that were weighed and priced at the checkout counter. The same experimental design was used for each study:

Store ---	1	2	3	4	5	6	7	8
Week								
1	x	x			x			x
2			x	x		x	x	
3	x		x	x	x			
4		x				x	x	x

In the diagram, x marks the stores in both studies that sold film-wrapped bananas during a particular week; the unmarked stores are those that sold tape-banded bananas in study one and nonbanded bananas in study two.

Table 10 shows banana sales and shrinkage during the 4-week test period of study one. Table 11 shows banana sales, markdowns, and trash during the 4-week test period of study two.

BANANA SALES IN RETAIL STORES

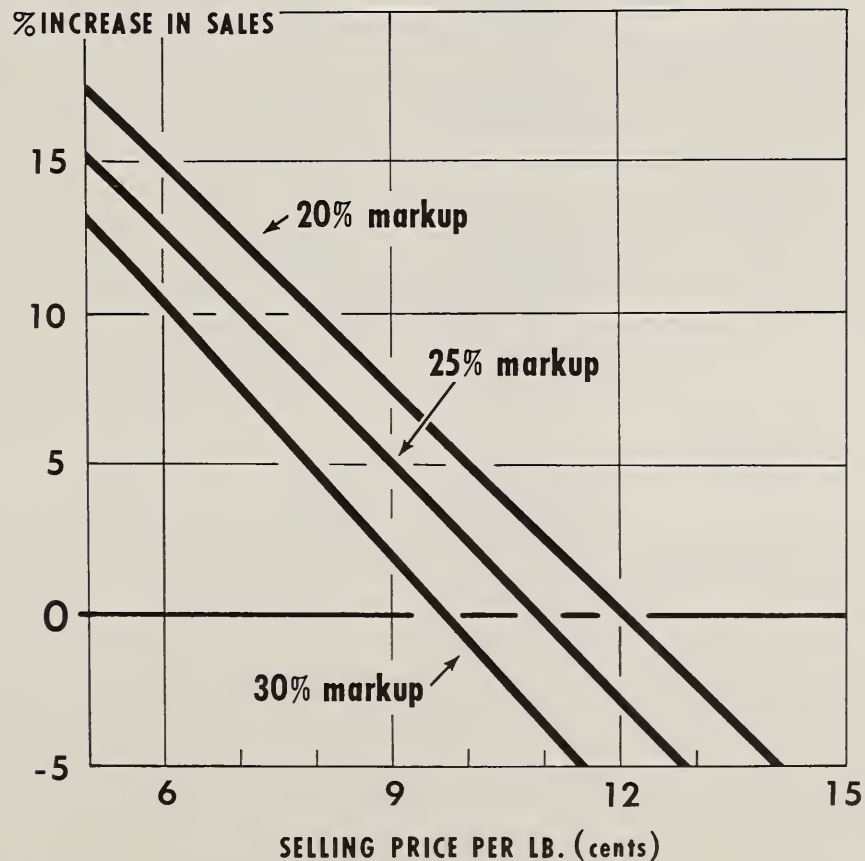


Figure 6.--Banana sales required at different selling prices and markups for tape-banded bananas to equal the net operating profit of nonbanded prepriced bananas.

TABLE 10.--Tape-banded bananas prepared at retail store and film-wrapped bananas prepared at central warehouse: Sales and shrinkage of bananas in 8 stores, by weeks¹

Item	Stores selling		Difference ²
	Film-wrapped bananas	Tape-banded bananas	
<u>Percent</u>			
WEEK ONE			
Banana sales.....pounds..	6,367	5,975	
dollars..	1,115	1,061	+5.1
Produce sales.....dollars..	18,461	16,955	+8.9
Banana sales as percent of produce			
sales.....percent..	6.2	6.4	
Shrinkage.....pounds..	124.5	215	
WEEK TWO			
Banana sales.....pounds..	6,167	6,274	
dollars..	991	1,007	-1.6
Produce sales.....dollars..	15,749	16,325	-3.5
Banana sales as percent of produce			
sales.....percent..	6.4	6.3	
Shrinkage.....pounds..	54	56	
WEEK THREE			
Banana sales.....pounds..	5,394	5,820	
dollars..	1,024	1,103	-7.2
Produce sales.....dollars..	13,747	15,621	-11.9
Banana sales as percent of produce			
sales.....percent..	7.5	7.1	
Shrinkage.....pounds..	66	86	
WEEK FOUR			
Banana sales.....pounds..	5,505	5,428	
dollars..	1,042	1,029	+1.3
Produce sales.....dollars..	20,010	18,445	+1.1
Banana sales as percent of produce			
sales.....percent..	5.2	5.0	
Shrinkage.....pounds..	45	76	
FOUR-WEEK TOTALS			
Banana sales.....pounds..	23,433	23,497	
dollars..	4,172	4,200	-.7
Produce sales.....dollars..	67,967	67,346	+.9
Banana sales as percent of produce			
sales.....percent..	6.2	6.3	
Shrinkage.....pounds..	290	433	

¹Figures in each column are totals for four stores; see discussion of experimental design.

²Difference in sales of stores selling film-wrapped bananas from those of stores selling tape-banded bananas.

TABLE 11.--Nonbanded bananas prepared at retail store (weighed and priced at checkout counter) and film-wrapped bananas prepared at central warehouse: Banana sales, markdowns, and trash in 8 stores, by weeks¹

Item	Stores selling	
	Film-wrapped bananas	Nonbanded bananas
WEEK ONE		
Banana sales.....pounds..	6,552	9,755
dollars..	884	1,311
Markdowns.....pounds..	282	924
Markdowns as percent of total pounds sold...percent..	4.3	9.5
Trash.....pounds..	356	255
Trash as percent of total pounds sold.....percent..	5.3	2.6
WEEK TWO		
Banana sales.....pounds..	10,325	7,039
dollars..	1,444	917
Markdowns.....pounds..	22	1,028
Markdowns as percent of total pounds sold...percent..	.2	14.6
Trash.....pounds..	65	653
Trash as percent of total pounds sold.....percent..	.6	9.3
WEEK THREE		
Banana sales.....pounds..	6,189	9,144
dollars..	856	1,221
Markdowns.....pounds..	174	852
Markdowns as percent of total pounds sold...percent..	2.8	9.3
Trash.....pounds..	152	237
Trash as percent of total pounds sold.....percent..	2.5	2.6
WEEK FOUR		
Banana sales.....pounds..	14,219	11,285
dollars..	1,570	1,184
Markdowns.....pounds..	296	589
Markdowns as percent of total pounds sold...percent..	2.1	5.2
Trash.....pounds..	224	313
Trash as percent of total pounds sold.....percent..	1.6	2.8
FOUR-WEEK TOTALS		
Banana sales.....pounds..	37,285	37,223
dollars..	4,754	4,633
Markdowns.....pounds..	774	3,393
Markdowns as percent of total pounds sold...percent..	2.1	9.1
Trash.....pounds..	797	1,458
Trash as percent of total pounds sold.....percent..	2.1	3.1

¹Figures in each column are totals for four stores; see discussion of experimental design.

COST FOR WEIGHING AND PRICING BANANAS PACKAGED AT SOURCE

Labor

Labor requirements and costs for various methods of weighing and pricing bananas that are film wrapped in the growing area are given in table 12.

Equipment

Central warehouse.--Equipment ownership and operating costs for weighing and pricing with the electronic computer scale at the central warehouse were based on use of the equipment listed for the experimental packaging line, with the exception of the roll-film packaging devices and heat-shrink tunnel. Depreciation, interest, and maintenance costs were computed in the manner previously described (p. 21). The total cost per 40-pound box of bananas, for an annual volume of 156,000 boxes, would be 0.7 cent.

The equipment used for weighing and pricing with the electronic computer scale and automatic labeler is the same as that listed for the improved banana packaging line, with the exception of the heat shrink tunnels and semiautomatic film-sleeve banders. The equipment ownership and operating cost per 40-pound box of bananas, for an annual volume of 156,000 boxes, would be 1.8 cents.

Retail store.--The equipment costs for pricing source-packaged bananas at the retail store are the same as reported for preparing bananas for sale. When performed in the backroom or at a customer service station in the produce department the only equipment used is a scale and a table. The cost per box is 2.5 cents. When weighing is performed at the checkout counter, the cost for scales and additional counters is 4.4 cents per 40-pound box.

Burden

The burden charges for weighing and pricing source-packaged bananas at the central warehouse or in the backroom or at the checkout counter in the retail store are the same as for similar methods of preparing bananas for sale. When the source-packed clusters were weighed and priced at the customer service station in the produce department, an area of 15 square feet was required. In this study, 20 percent of the produce items weighed at the service station were bananas. At \$2.46 per square foot, the burden was \$36.90 and the cost per 40-pound box was 0.5 cent.

TABLE 12.--Labor requirements and costs per 40-pound box to weigh and price banana clusters film wrapped in the growing area, by various methods at the central warehouse and retail store

Method and labor elements	Labor required	Cost
CENTRAL WAREHOUSE, ELECTRONIC COMPUTER SCALE		
	<u>Man-minutes</u>	<u>Cents</u>
Position box on conveyor and remove top.....	0.110	0.56
Remove clusters from box and position on conveyor...	.550	2.10
Position clusters on scale, attach label, and place cluster on turntable.....	1.100	4.20
Obtain empty box.....	.053	.20
Position clusters in box.....	.660	2.52
Place top on box and push box down conveyor.....	.104	.40
Stack boxes in palletloads on conveyor ¹.....	.050	.26
Total.....	2.627	² 10.72
CENTRAL WAREHOUSE, ELECTRONIC COMPUTER SCALE WITH AUTOMATIC LABELER		
Labor elements are the same as above except for: "Position cluster on scale, attach label, and place cluster on turntable," all of which is done automatically.....	1.527	³ 6.34
RETAIL STORE, LOW-PLATFORM SCALE IN BACKROOM		
Improved method:		
Obtain box and open.....	0.200	1.00
Remove clusters, weigh, write price on clusters, and return to box.....	3.190	15.95
Place top on box and place box on cart or back in storage.....	.233	1.16
Miscellaneous weigh elements.....	.317	1.58
Total.....	3.940	⁴ 19.69
Typical method ⁵	8.58	⁴ 25.74
RETAIL STORE, LOW-PLATFORM SCALE AT CUSTOMER SERVICE STATION IN PRODUCE DEPARTMENT		
Obtain cluster from customer, weigh and write price on cluster, and return to customer, including delays ⁵	11.132	47.30
RETAIL STORE, LOW-PLATFORM SCALE AT CHECKOUT COUNTER ⁶		
Place cluster on scale, read price and remove from scale.....	1.408	5.98

¹This work could be done by an automatic palletizer.

²Average wage rate is \$2.45 per hour (4.1 cents per minute) for a crew of one male at \$3.08 and 4 females at \$2.29 per hour.

³Average wage rate is \$2.49 per hour (4.2 cents per minute) for a crew of one male at \$3.08 per hour and 3 females at \$2.29 per hour.

⁴Wage rate is \$3.00 per hour.

⁵Labor requirements and costs were obtained from a week's study in 4 stores, and the total labor for weighing and pricing bananas was divided by total boxes received.

⁶This represents the time requirements for weighing produce items beyond the normal checkout time. Average wage rate is \$2.55 per hour.

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